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# The MONTHLY REVIEW

Published by the AMERICAN ELECTRO-PLATERS' SOCIETY

*A Society*
*for the Advancement of the Science of*
*Electro-Plating*

**AUGUST 1936 • IN THIS ISSUE**


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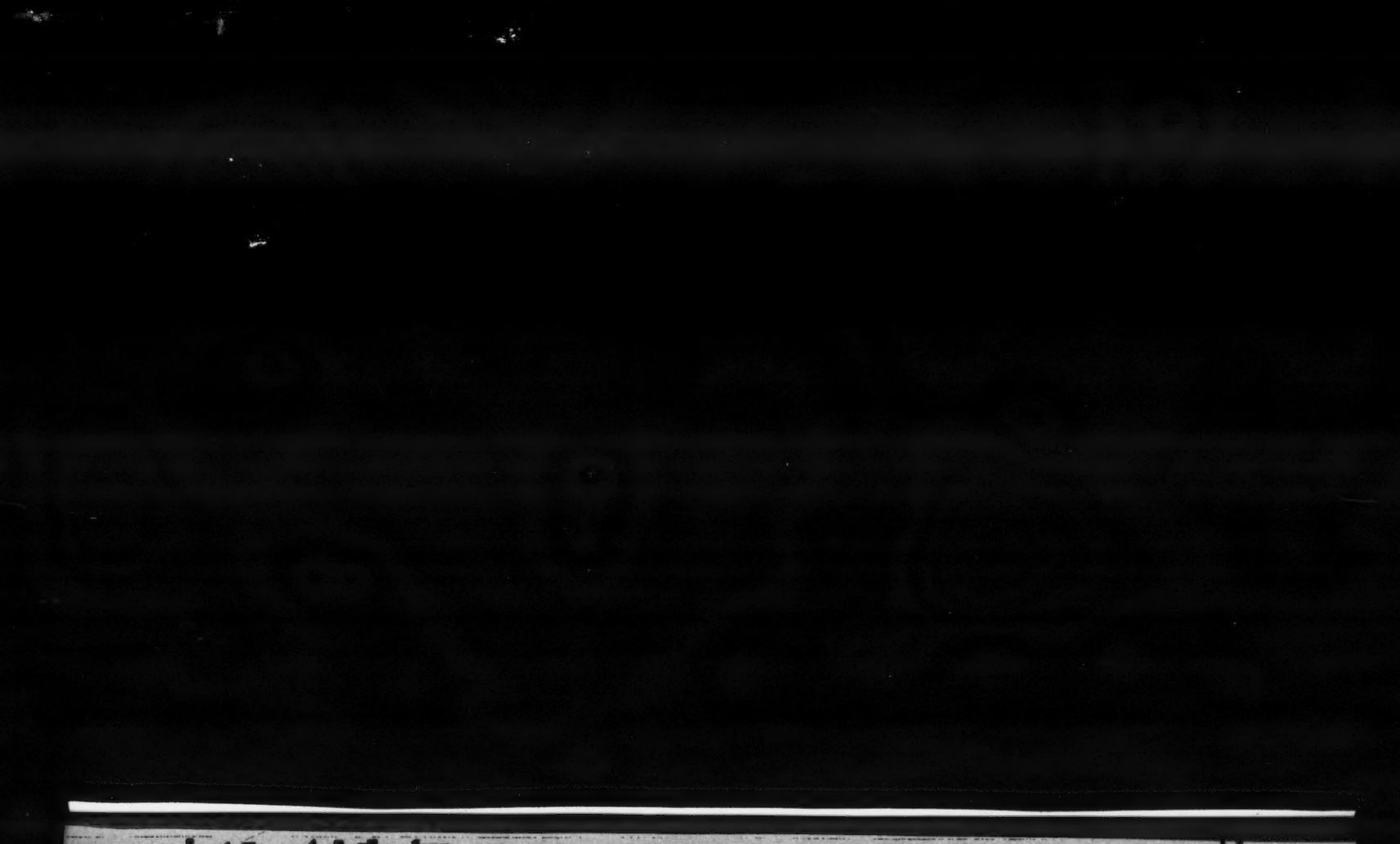

# The MONTHLY REVIEW

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## *Editorial*

In looking over the news received from many of the secretaries this month, attention is called to the social events conducted by the branches. The Boston members held such an outing on Saturday, July 25, at Hull. Rochester and Binghamton-Elmira had a joint get-together at the Three River Point Inn near Syracuse on July 18. Chicago and Milwaukee Branches are anticipating a great time at their picnic to be held at Antioch, Ill. about August 16, and the Connecticut Branches are planning for a similar event later this month.

In the summer months when our branch activities cease, outings, picnics, steak roasts, or whatever we may call them keep us together, cement friendships, give us a chance to indulge in our favorite pastime, whether it be fishing, swimming, golfing, baseball, or an old-fashioned gossip, (which the men seem to enjoy as much as the ladies.)

There is also the privilege of the whole family, husband, wife, and children forgetting the cares and anxieties of this much too crowded existence of ours and enjoy for a day at least the fellowship and good cheer always connected with events of this nature.

In addition to the social side of these occasions, there is the possibility of increasing our membership by a personal invitation to those not connected with A.E.S. We saw this fully demonstrated at the Boston Outing, where the spirit of enthusiasm and friendliness was so manifest that several non-members were so favorably impressed that they decided to come in and be one with us.

It may not be possible to figure out in dollars and cents the results of such meetings as these, but no one can doubt the big dividends they pay in comradeship and good-will.

# Columbium *as a Commercial Product*

*By JAMES H. CRITCHETT*

The development of columbium from a laboratory curiosity to a widely used commercial product formed the Presidential Address to the Electro-chemical Society delivered by Mr. Critchett, a Vice-President of the Union Carbide and Carbon Research Laboratories. An extract from this address is given below.

Columbium is not a newly discovered metal. It has been known for some time as a member of the family of tantalum and columbium, although rather a poor relation and quite a drag on the head of the family for it could not seem to find a useful job to do. It was always under foot and had to be expensively got out of the way before the noble member of the family, tantalum, could go to work. But the poor relation has lately been converted, has found a useful and important job, and therein lies my story.

The conversion of columbium was brought about by Dr. F. M. Becket, past president of this great Society, who found important work for it to do. We are all familiar with the stainless steels and the valuable member of that group containing 18 per cent. chromium and 8 per cent. nickel which fills so many needs of chemical equipment, through food handling machinery to pots and pans and kitchen sinks. Valuable as that steel was, it has a serious drawback in that, if heated, its carbon content, even though very low, precipitated at the grain boundaries of the crystals and so lowered the corrosion resistance at this point that the steel lost its ability to withstand chemical attack. As a consequence the steel could not be used in chemical processes at elevated temperatures, apparatus could not be fabricated by welding, and when equipment had to be spun or deep drawn, it had to be drastically heat-treated, so much so as to be impossible in complicated designs.

In working on this problem Dr. Becket discovered that columbium combines with the carbon in stainless steel and removes it, so that all its harmful results are eliminated. But the solution of this problem only created more problems, for in order to be a

commercial answer, columbium had to be available in sufficient quantity to treat the 25,000 tons of 18-8 stainless steel then being made each year, with large increases of that tonnage in early prospect. This set the requirement at about 300,000 to 500,000 pounds a year for the start and an increasing amount after that. No such quantity of columbium was in sight. You will note that the first approximation to the answer, as a mathematician would express it, was the brain child of an individual. From here on, the final solution, the exact answer, became the work of an organisation.

First, the search for the columbium ore. It is known to occur only in pegmatite dikes, those volcanic extrusions through the earth's crust. But every pegmatite dike does not contain columbium and none was known that contained quantities of ore rich enough to meet the need. So the mining-engineering department of our company started searching such locations as North Carolina, and the Black Hills in the States and the Laurentian Highlands in Canada, but without success. The search next spread out through many foreign lands and finally reached its goal in Africa. Do not ask me what hint led the geologist to the right spot. It suffices to know that once there is need for any metal or element, it is finally found somewhere on this earth of ours.

Again, however, discovery of an extensive columbium ore body merely gave rise to a new set of problems. Like all ores of such origin as columbite, it was quite impure. Before a ferrocolumbium alloy could be produced from it that was pure enough for use in such a high-grade steel as stainless, the impurities had to be got rid of. So the chemical engineers and electro-metallurgists of the research department of our company undertook the purification of the ore and its reduction to the alloy. Fortunately, this African columbite was low enough in tantalum so that the difficult and expensive separation of the two metals could be avoided. However, tin was present to an extent that required elimination. Either preliminary selective reduction followed by chloridising and volatalisation of the tin chloride or selective reduction in a liquid bath that permits

liquation of the reduced tin, both work. Following this purification, reduction with a metallic reducing agent, such as silicon or aluminium under electric furnace conditions, yields an alloy of iron containing about 55 per cent. of columbium which is entirely suited to the needs of the steel maker.

In the meantime the steel metallurgists of our research department had been busily at work discovering more and more about how to add the metal to the steel, how much is needed for various kinds of uses to which the steel may be put, and how to roll, heat-treat, and weld and otherwise fabricate the steel into useful articles.

So here you have a metal, columbium, new, at least in the commercial sense, born, developed through adolescence and at last brought to maturity. Now this development from conception to completed commercial success illustrates several things that are important in society as now constituted.

First, let me say that it again brings out the breadth of knowledge necessary to carry through any major development. Metallurgy of steel and iron, mining, electrometallurgy, chemistry all played their part and electrochemists conceived, developed and supervised this complete work, emphasising to our mind in a very practical way the great value of electro-chemical training as a co-ordinator of the many sciences.

Next, this development illustrates well the fact that society as a mass has no specific wants other than those comprising the few basic necessities of life. It has only the capacity to want and desire better conditions and better products leading to greater happiness. It is the privilege and duty of scientific and technical men to conceive those things which, once realised, first become the wants and later, the necessities of society, thus gradually furthering and rounding out our material civilisation. Finally, this columbium development emphasises the inter-dependence of our numerous sciences and the great advantage that results from the close co-operation of those skilled in its many branches.

# *The Use of* **Metal Rectifiers** *for* **Electroplating** *in England*[1]

## I. INTRODUCTION

*By RICHARD M. WICK*[2]

**Read at Cleveland Convention**

WHILE great advances have been made in electrodeposition during the past fifteen years, practically all of the investigations were concerned with improvements and refinements in known processes and equipment, and with the establishment of the principles underlying the electroplating processes. Today, research on electrodeposition is being undertaken even more vigorously than before, and with a bolder purpose. It is interesting, therefore, to note that wholly new processes and types of equipment are beginning to appear. Electroplating processes, methods and equipment engaged the writer's attention during a trip to England, France, and Germany in 1935. Many interesting observations were made, one of which was on the use of "metal rectifiers" (or more strictly, oxide-film rectifiers) for the conversion of alternating current to low-voltage direct current for use in electroplating. On returning to America, the writer found that information was not readily available here concerning this development, although its use in electroplating under American conditions was being investigated.

In this paper a short description of the construction and operating characteristics of metal rectifiers is presented. The material summarizes the personal observations of the writer in some of the plants where the equipment is in use, and the results of conversations with the users and with the technical staff of the Westinghouse Brake and Signal Company in London, where these rectifiers are now being manufactured for electroplating. The author has had no first-hand experience with this equipment.

The disc type of cuprous oxide-metal rectifier was invented by

[1]Publication approved by the Director of the National Bureau of Standards of the U. S. Department of Commerce.

[2]Chemist, National Bureau of Standards.

Dr. L. O. Grondahl of the Union Switch and Signal Company in Pennsylvania, and was first used in radio. Recently this use has diminished, but numerous other applications of the disc type have been developed.

The plate type of rectifier and the method of making contact with it were devised in Germany by the Siemens-Schuckert Werke. The Westinghouse Brake and Signal Co., Ltd., of London, England, then started to manufacture large plate rectifiers for use in electroplating, and has promoted this use in England.

## II. STRUCTURAL FEATURES OF THE METAL RECTIFIER

The low-voltage direct-current power supply required by all electro-plating processes is now provided in the United States by motor-generators. Storage batteries are used only as a "stand-by" or emergency power supply, or for very small plating operations. A motor-generator set is operated by either alternating or direct current at line voltage, and produces direct current at the voltage required by the electroplating process. A metal rectifier is capable only by converting alternating current to direct current; if the power source is direct current the use of a rectifier is unnecessary, but a D.C. motor-generator is necessary to "step-down" the voltage.

The complete metal rectifier equipment consists of a transformer and a battery of rectifier plates. The transformer reduces the voltage of the alternating-current from the 220, 440, or 2200 volts that exists on the power lines to nearly the voltage required by the electroplating process. Practically, a slightly higher voltage is produced by the transformer in order to allow for the voltage drop through the rectifier.

A rectifier plate consists of a film of cuprous oxide formed on copper. Its operation is based on the fact that such a film offers a low resistance to the passage of an electric current from the oxide to the copper and a high resistance in the reverse direction. Since an alternating current, as the name implies, is a current which is reversed in direction, usually 60 times per second, it is apparent that a single plate on which has been formed a cuprous oxide film will permit current to flow during only half of each

cycle. This does not mean that only half of the alternating current is utilized, however, for the arranging a suitable circuit the other half can be joined, in effect, to the first to form an unidirectional or direct current.

The plate form of rectifier assembly has permitted the construction of equipment having the large current-carrying capacity which is needed for electrodeposition. In the preparation of the rectifier plates, copper is oxidized on both sides so that a film of cuprous oxide with the desired properties is formed. The film is then sprayed with metal in order to permit an electrical contact to be made with the oxide. The other contact is made directly to the copper after a small area is scraped free from oxide.

Heat is generated by the passage of the current through the rectifier plates. Forced cooling by means of a small fan that is mounted as a part of the unit is used to dissipate this heat. The rectifiers are designed to operate at full load with only a nominal temperature rise, which is less than occurs in many other types of electrical apparatus. Sustained overloads would undoubtedly decrease the useful life of the cuprous oxide film, but no damage occurs as the result of even heavy overloads for short periods. The rectifiers are designed for continuous operation at rated full load. Circuit breakers and fuses are provided for protection against short circuits, failure of cooling fans, or other interruptions.

The metal rectifier may be used with either single-phase or three-phase alternating current. The single-phase circuit shown in Fig. 1* is commonly used only for small units, of less than 1 kva capacity. For larger units, a three-phase circuit is employed, (such as is shown in Fig. 2). Even with the three-phase circuit there is a slight voltage ripple, shown in Fig. 3. This is stated to be of the order of 7% with the 50-cycle current used in England, which is no greater than the commutator ripple in a direct-current machine. Fig. 4 shows an oscillogram of the rectified current from the single-phase circuit.

The floor space required by the rectifier is small in comparison with its current capacity. For example, a 1000-ampere unit requires a floor space of approximately 10 square feet. Provision should be made for a supply of clean air for the ventilation

of the rectifier. Gauzes are provided in the ducts to exclude dirt particles. No trouble is experienced with condensation of moisture, since the temperature within the rectifier is always above room temperature.

## III. OPERATING CHARACTERISTICS

Metal rectifiers have been available in England for commercial electrodeposition for a little more than a year and a half. Life tests have been made in the laboratory as well as in the actual service. These tests included operation at high temperature and under continuous overload, as well as normal operation. As a result of these tests the English engineers have concluded that during the first year or two of use an initial "settling down" process occurs, which results in a slight reduction of the output of the rectifier. Allowance for this has been made in the design so that the rectifier may be adjusted to its original output. After being restored to its initial value, no further changes are expected to occur for a considerable period.

Several years of observation under operating conditions will be required for an accurate estimate of the life of metal rectifiers. The results of laboratory tests, and of service tests for nearly two years, encourage the belief that the ultimate life will compare favorably with that of the existing motor-generator equipment.

The electrical efficiency of the metal rectifier under different conditions of load is shown in Fig. 5. Two curves are shown in this figure, one for production at 4 and the other at 6 volts. (To double these voltages, two units are generally placed in series, and the over-all efficiencies are practically unchanged). For the 6-volt rectifier the maximum efficiency, as read from the curve, is a little less than 80%. Seventy-five per cent efficiency is reached at 25% current load, and at the full load, the efficiency is a little higher. The values for the 4-volt rectifier are about 10% less than for the 6-volt equipment.

At 50% current load, the power factor of the metal rectifier is 0.9, which is very good; while at 25% load it is 0.8. These values are superior to the power factors of induction motors used in motor-generator sets, but not of synchronous motors.

With increasing load, the output voltage of the metal rectifier

decreases. The rated output voltage of the metal rectifier is specified at full load, and hence at less than full load, the output voltage will be higher. At half load the voltage is approximately 10% and at one-quarter load about 19% above the voltage at full load.

A push-button control, which may be located, if desired, both at the rectifier and the tank, serves to connect or disconnect the rectifier and the plating circuit. The output voltage of the metal rectifier may be controlled at the primary coils of the transformer, which are provided with taps so constructed that changes can be made either with the current flowing or with the apparatus disconnected from the circuit. In the latter case, changes in the primary connections are made in a short time. This off-load control has been found to be satisfactory in most plating operations. The on-load tap control is located within the transformer tank, but if desired it can function as a remote control.

A moving-coil regulator for the transformer is a feasible method of control, especially where fine adjustment of voltage is essential. Such a device, which may be made automatic, increases the complexity, and therefore the cost, of the apparatus. This type of control is probably necessary only for laboratory equipment.

The usual resistance-board control at the tank is as adaptable for use with a metal rectifier as it is with a motor-generator. Since the economy of the metal rectifier is best realized when connected directly to the plating tank, it is preferable not to use a resistance-board in the circuit.

## IV. EQUIPMENT AVAILABLE AND IN USE IN ENGLAND

The Westinghouse Brake and Signal Company lists three-phase rectifiers having 6-, 8-, and 10-volt output, and single-phase units of 3.5 and 4.5 volts. The latter are cooled by natural convection for less than 175 amperes output, and the former for less than 100 amperes. All of the larger sizes are fan-cooled. The rated current capacity of the three-phase units is from 50 to 12,000 amperes in the 6-volt, and up to 6,000 and 5,000 amperes in the 8- and 10-volt sizes respectively.

In designing an installation which includes metal rectifiers, advantage is taken of the possibility of eliminating tank switchboards by specifying, for each process, the individual rectifier which is best suited to it. For example, a 6-volt unit might be used for electro-cleaning and electro-pickling, a 3-volt unit for nickel or cadmium plating, and an 8- or 10-volt rectifier for chromium plating. It is not uncommon in present practice to operate all these processes from a single motor-generator set in conjunction with individual tank switchboards. With metal rectifiers, the losses at these switchboards are eliminated and a considerable saving in power is effected.

The metal rectifier has had a remarkable acceptance in England. Within a little more than a year and a half the plating departments of many large plants have changed from motor-generators to metal rectifiers. One electroplating plant in England has a metal-rectifier capacity of 100,000 amperes. The Hercules Bicycle and Motor Company has a capacity of 28,000 amperes, which includes one 5-volt 12,000-ampere unit for nickel plating. In this installation 7-volt rectifiers are used for chromium plating, although the Westinghouse Company now believes that the 6-volt size is adequate. This is significant, since the 7-volt machine is actually a modified 12-volt installation, whereas the 6-volt machine is a simple unit. The Morris Oxford Company, which manufactures a considerable number of small cars in England, originally tested a 1000-ampere unit. In a short time a 3500-ampere unit was acquired and finally a 12,000-ampere unit, and it is reported that no motor-generators sets are now in use in this plant. The rapidity with which metal rectifiers have been accepted by the plating industry in England indicates that this equipment possesses considerable advantages.

In general the best results with metal rectifiers are obtained by using solutions which have a wide plating range. These are advantageous because of the relatively coarse control of voltage which is provided on most of the rectifiers, and because of finer control increases the cost of the equipment. In one plant, chromium was satisfactorily plated with a metal rectifier from a solution which was said to have a very wide bright-plating

range. For steady production on similar parts, the necessity for this wide range diminishes, but it is probable that for miscellaneous or job work a solution having such characteristics would be highly desirable. Indeed, such a solution is desirable even when close control of voltage is available.

The advantages of a static source of power, such as the metal rectifier, will be found in the reduced power consumption consequent on the higher efficiency of the unit, the negligible power requirement at no load, and the possibility of eliminating tank switchboards through the use of individual rectifier units located at or near the tanks. The upkeep of a metal rectifier is negligible compared with that of a motor-generator, since it requires no lubrication, brush replacement, or commutator maintenance, and bearing troubles are eliminated.

## V. CONCLUSION

The writer holds no brief for the metal rectifier, but it was not possible to remain unimpressed while in England by the almost spectacular extent of its applications. Until this development, the progress in power-supply equipment for electroplating was in the improvement of motor-generator construction. This was very effective, and today the motor-generator set is a refined instrument of proved usefulness. The metal rectifier, as developed in England, is the first radical change from the older method which has received commercial acceptance in electroplating. Large plate rectifiers are not commercially available at this time in America, but they are now receiving thorough consideration. Such a study will benefit from the practical experience gained in England and will no doubt include a comparison with other proposed types of equipment, such as the general transformer, as well as with the present or improved motor-generator sets.

Should this type of equipment become economically advantageous, research on the modification of present plating solutions or on the development of new ones, in order to provide a wider range of conditions for producing satisfactory electrodeposits, will be stimulated. This result would of course be an advantage even with existing equipment.

## DISCUSSION

PRESIDENT SLATTERY: Are there some questions you would like to ask Dr. Wick in reference to metal rectifiers?

MR. M. R. BERRY: My remarks are more in the nature of an answer to the British viewpoint on the subject of rectification. I have personally been very much interested in rectifiers for the last twenty-eight years, since, really, the invention of the Mercury Arc rectifier that was applied years ago to the matter of battery charging. Then later on in Atlanta, twenty-five years ago, we built a vibrating type rectifier and used that for quite a while. Then various types of rectifiers — the copper oxide rectifier, for instance — have been coming along in rather natural sequence, and at the last meeting of the Electro-Chemical Society there was a paper written on the vibrating rectifier that we had developed years ago and rather given up for some very good, we thought, mechanical reasons.

The Doctor's sources have been very frankly, as given by him, British sources, and I have felt, as I have listened and read from the British Sales Bulletin, which I sent to England for at the time I first heard of the announcement of this talk being given, like a Rip Van Winkle who had awakened after a sleep of about twenty-five years.

For instance, these are some of the remarks that are made as a basis of the British design of an improvement, and these remarks are made about present-day motor-generators. I quote from the Bulletin: "It is quite impossible to run a motor-generator at full load for an unlimited time." Again, "The mean efficiency of a motor-generator would not exceed fifty per cent." Again, "The power factor of the induction motor is notoriously bad, and when considering any financial comparison between metal rectifiers and motor-generators, allowance must be made for the necessary apparatus required to correct." Again, "Rectifiers can, of course, be used in conjunction with resistance boards," which I interpret

as tank rheostats, "when the method of operation is identical to that employed with a motor-generator set."

Such seems to be the British mind picture of the modern motor-generator, which he uses as his base comparison. Such a generator set passed into the limbo of the forgotten just about twenty-five years ago in these good United States of America.

In examining the merits of the modern copper oxide rectifier, I will compare it in a few essential details with the real present day motor-generator, explaining that the copper oxide rectifier was developed in America and most of the research work done here likewise. Life tests of these rectifier plates have been running continuously in this country since 1925 or thereabouts and still continue. There have been a number of these copper oxide rectifiers tried out, and they have been sold in the motion picture industry for rectifying alternating currents.

I might give you a little picture of just what the process of rectification that goes on in one of these rectifier plates is. There is an arc. A great many types of metallic arcs possess rectifying properties. For instance, when they first brought out the Mercury Rectifier years ago they used to call it a mercury valve because it possessed a high resistance to the flow of current in one direction and a very low resistance in the other direction. Research work was done in this country for many years on various types of arcs and it showed all arcs possessed some type of rectifying properties.

You will recall the little crystal detector that we used on radio sets in years gone by, and the fact that it was used as a rectifier for those very small radio currents. Well, one of the theories for that was that in two contact areas there is a microscopic arc set up there, and it is that arc in fact that possesses the rectifying properties, and one of the theories about these copper oxide rectifiers is also based on that theory.

They started out with the development of copper oxide rectifiers in this country by using what they call the inch and a half disc. It was a disc of pure copper, and they tried electrolytically depositing an oxide film on it, but they finally arrived at the point where they would take these pure copper discs, heat them to a certain temperature, and then immerse them in some cooling medium, and that would deposit on the outside layer of these

copper discs an oxide. On the outside would be a cupric oxide film and just between the cupric oxide film and the mother metal at the bottom would be the cuprous oxide. They found the rectifying took place between the cuprous and the mother metal, but the cupric film acted as the deterent so that was finally ground off. They have done a great deal of experimental work in trying to find the best way to make a contact with that outside copper area in order to carry out the theory of getting the rectifying properties on the inside as efficient as possible and reducing the contact and therefore the temperature rise due to the contact resistance to as low a point as possible.

I mention that analogy because it is necessary in understanding some of the other details about what we shall term the aging. When we come to arcs and their rectifying properties, we find they all possess that fundamental defect of aging. The Mercury rectifier had a very definite life span, because of the changes that took place on the surface of the metals. They find that in these copper oxide rectifiers, aging is probably the worst problem they have in connection with them. We find that in connection with crystal detectors, where you need to keep offering a new face to the tickler wire that touches it. I bring up those analogies in order that you might keep them in mind in understanding this detail.

I also deem it eminently fair to use the published data from the research laboratories as authentic. Fortunately the laboratory data I shall quote is later than any other available facts, having just appeared in the May, 1936 issue of the General Electric Review.

In comparing these two differing methods, let us discuss the subject under the following brief heads:

*Power Factor.* I do not need to tell you gentlemen that the induction motor has long since disappeared as the driving motor for the motor-generators except, of course, in very small places which operate at high speed. The induction motor is still the standard in the European countries, and they are using that as the base comparison. Apparently nothing in the literature there indicates that they considered using synchronous motors to drive their generator sets in the old country.

Here is an interesting thing: They make a great point of the fact that it is a heavy penalty that you manufacturers are suffering because of the fact of your low power factor on the induction motors, and yet the curves indicate that as the load drops on the rectifier, the power factor goes down. In other words, your rate penalty increases as the load drops.

The synchronous motor drive on a generator set has just the opposite characteristic, and that is whatever power you are not taking out of that driving motor to drive your generator still has a very important function in correcting the power factor in your factory to the extent of the power factor correcting that synchronous motor. In fact, we have many users of our motor-generator sets that during periods when they are not being used for plating purposes drive them idle just for the power factor corrective value that they get, and the lowering of the rate structure that they get in many places where there is a penalty for the low power factor. So in the first comparison of power factor, instead of there being a disadvantage, there is a decided advantage in the use of the motor-generator.

*Tank Rheostats.* The cost comparisons are all based on the assumption that all motor-generators must needs employ tank rheostats while the rectifier will be selected in multiple sizes to fit each separate tank. He uses a classic example there of a 3-volt operation and a 6-volt operation and a 12-volt chromium plating operation, and assumes they all have to be driven from the same motor-generator sets. In considering that in this country the cost of two 5000-ampere motor-generator sets is less than one 10,000-ampere generator set, then you will understand that there is no need in the world for any manufacturer to use one generator through a lot of tank rheostats when he can buy multiple motor generator sets without an appreciable difference in cost.

*Efficiency.* There is a great deal of data on the subject of the efficiency of the copper oxide rectifier, but not a great deal of it is consistent enough to be able to tie it together. For instance, in the efficiency curve that Dr. Wick showed us here, we had somewhere around 79% theoretical maximum efficiency

under the maximum voltage conditions, and somewhat lower as the voltage was lower.

The technical data just published in the General Electric Review shows the unit efficiency of these copper oxide elements at 52% new and approximately 45% when aged. The earlier curves show about 55% maximum *new* for 4 volts A.C. impressed upon a unit rectifier. Dr. Grondahl, the inventor, in one of his published articles in 1933, speaks of the discrepancies between laboratory efficiency figures and actual values, and suggests the use of fully fifteen points lower values for average use conditions as contrasted with laboratory results.

Now let us understand why that is necessarily true. Here is a certain plate, an individual plate. We can put that in the laboratory and measure the efficiency across that particular plate. We have practically uniform temperature conditions on both sides. We probably can adjust our pressures so as to get uniform pressures for contact drops between different points on that curve, but now when we take one of the rectifiers such as we saw in the picture here with the fan mounted at the top, drawing its cold air from the bottom, that air passing all the way up through those very long narrow passages, we can understand that there will be very different temperature conditions from the bottom where it would be coolest to the top where it would be the warmest. Those are the factors. Temperature has a great influence on the copper oxide rectifier, so that in use conditions, in different parts in that structure you will find that there will be very different mechanical conditions which will very easily account for these variations in efficiency that Dr. Grondahl himself points out.

Unfortunately, in the efficiency curves that Dr. Wick has shown here, it is not indicated whether those are new values or whether they are aged values, but in this research work that has been done at the General Electric laboratories, they show this very interesting curve: At the end of one year the effect of the rectifier had dropped enough so that they needed to make adjustments in the alternating current voltage; that is, step up the primary voltage, increasing the kilowattage to get the same output. You can not increase the primary kilowattage without

lowering the efficiency. To get the same output from the machine, if you have to increase the kilowatts, then the difference is the loss in efficiency. That loss in efficiency is represented by more heat that has to be dissipated. At the end of the second year they did the same thing. They had to step it up still higher. At the end of the third year they stepped it up still higher. At the end of the fourth and a half year, they stepped it up still higher. These were theoretical laboratory units that were being tested; they were not service units. So when Dr. Grondahl acknowledges the fact that there is a big difference in the efficiency, then we do not know what conditions would be necessary under service until they have been under service conditions much longer than they have.

Tests on commercial rectifiers for motion picture projection reveal not over 60% new and, if the recently published curves showing decrease in efficiency with age are authentic, one should not credit an average life efficiency of over 50%. I am taking the 60% and taking off the 15% that Dr. Grondahl says they will drop with age and that will give us 45%, and then I am adding 5% for good measure to be generous.

When this is compared with a modern motor-generator in sizable installations, it would seem fair to assume current consumption for the rectifier of fully 40% in excess of that required by the motor-generator.

*Maintenance.* The British author suggests a comparison in upkeep costs favorable to the rectifier, specifying brush and bearing replacements as an important item in the operation of motor-generators, these being the only essential mechanical wearing parts in the generator. But nowadays bearings are so universally generous in design that their normal life should be considered equal to that of the generator itself.

Brush life is more variable and more directly determined by such operating factors as sustained heavy overloads and general cleanliness. It is interesting and noteworthy, however, that these are the same factors which can render the rectifier practically inoperative. So completely clean must the rectifier units be kept that all air circulation must be constantly filtered and sustained overloads can cause high temperatures which, in turn,

destroy even the rectifying properties of these units and render them worthless.

I got that information from the Research Department of the Bell Telephone Laboratories who did a vast amount of experimenting on copper oxide rectifiers with the idea that they might make possible use of them in the hundreds, I might say millions and millions, of dollars worth of rectifying equipment that they have in use.

It is also interesting to note that one set of brushes for a generator is such short periods of replacement as once every three years would, for an average 5000-ampere 8-volt generator, cost less than $200.00, or $67.00 per year of operation, while the saving in current cost as suggested above for a similar average output would be somewhere around $375.00 per year with current near 1c. per kilowatt hour. Or, to cite an extremely ideal condition, a customer in Western Pennsylvania exhibited a few weeks ago a brush wear of 1/8″ in a 2″ long brush after more than five years of service. In a well designed generator brush costs are therefore insignificant.

*Voltage Regulation.* The rectifier curves show an inherent drop in voltage between no load and full load of 26%. An average value for the added drop between rectifier and tank would be about one-half volt, or another 8%, giving a total combined regulation of about 34% for the rectifier assembly. That is, if you would set your generator to give six volts at the generator, no load when you started it up, at your tank terminals you would get 34% less than six volts when it reached full load without any adjustments of the rheostat. For the motor generator this same difference can be specified as zero with entire satisfaction and with a slightly over compound design and with no extra cost.

For varying the voltage of the generator, a simple field rheostat is used, while the required changes in the rectifier must be made by transformer tappings on the primary of the transformer. Button to button changes can not be made as in the simple resistance field rheostat for this would short circuit, or open circuit the transformer at each change. It is not explained how these changes in the rectifier are made but transformer tappings

never possess the simplicity and ease of control of simple resistance control. In other words, when you short circuit the two terminals of a transformer coil, when you touch them together you short circuit. When you do the same with the resistance it makes no difference. You simply cut out that section of resistance.

These vast differences in voltage regulation, all so favorable to the generator, have a still greater significance in maintaining high quality and low cost and uniformity of deposit thickness, utterly impossible in the poorly regulated rectifier. The Sales Bulletin claims that this poor regulation can be overcome by special moving coil transformer regulators but does not record any successful installation of this kind and recommends against it on account of extra cost.

*Aging and Overload.* From the technical literature on the subject, this variation of the rectifier with age is its most difficult factor. The British information indicates "that there is an initial settling down process taking place over the first year or two of use, depending on the conditions under which the rectifier is operating." The technical published curves tell a more complete story. On a storage battery load without any ballast resistance, the initial output of the rectifier had dropped 50% in 250 weeks and was still dropping at the end of the test. I just spoke of another test that was made, where they stepped it up at four and one-half years from the time they started, although the Sales Bulletin says during the first year or so.

With a ballast resistance in series, this drop was only approximately half as much. That is a very interesting point. As Dr. Blum will bear me out, there is a very heavy counter E.M.F. factor just as there is in a storage battery. For instance, I happened to be at an installation which was made some years ago with a generator which was used to recover the scrapings of the copper wire when they were drawn through the dies. They took those solutions and put them in a tank and plated out that copper on copper cathode bars in order to recover it. As I was there, the engineer said, "I want you to explain to me some unusual factor here." I expect many of you gentlemen have seen the same thing at different times. That is, he cut off

the starting switch of the motor generator set, but the generator did not shut down. That tank continued to operate that motor-generator set, running the generator as a motor from the stored up storage battery energy in the plating solutions.

Another proof that the plating tank carries a much closer analogy to storage batteries than it does to a resistance load is the fact that changes in voltage at the terminals of the plating tank produce more than a proportionate increase in the current flowing into the tank, showing that there is a very heavy part of the loading in the tank which is counter E.M.F. or back pressure from the tank rather than a straight resistance load.

Unfortunately, they are not able to carry their life tests on a straight plating load continuously for a period of five or six years, but they have taken the storage battery as the nearest analogy to it. If we put in series with that load as resistance, then the aging effect of those rectifiers immediately gets more favorable to the rectifier. The difficulty is that when we put a useless resistance in series with that tank, we are paying for burned up heat energy that is giving us no value at all, but the only way I can account for that, and it is not explained by Dr. Grondahl or in any of the published articles on the subject, is that any factor in that copper rectifier that produces change increases the aging. Variable amperes passing through, variable voltage, variable temperature, all have an adverse effect in causing that aging, but that is a pure surmise on my part, but the curves do show that the more ballast resistance that is put in that tank, the less is the effect of aging. In other words, the more constant does this ballast iron out variations, and that has a favorable effect on the aging of the rectifier. On the straight resistance load from which the aging curves in the Sales Book are taken, it shows an even more favorable result, but those are not operating conditions such as you would encounter in plating service.

The curves above mentioned are laboratory curves obtained probably at constant loads and near constant temperatures. Dr. Grondahl warns against acceptance of such data as average service data. There is every indication that variables increase the aging factor and when, in service, voltage, current, and temperature are constantly subject to change, the results should be worse and not better.

Overloading seems to be an especially troublesome factor with these rectifiers, for they must be maintained for periods of short duration only in order to prevent temperatures reaching values which will shorten the life of the elements through increased aging or, even reach values which destroy the rectifying properties of the oxide film itself.

The record of the modern generator is, to the contrary, too well known to leave any doubt of its ability to carry sustained heavy overloads without permanent loss of efficiency or capacity. So many generators have been called on to do double duty in times of stress that confidence born of experience now prevails and the intending buyer will not have to consider, as in the case of the rectifier, the purchase of a unit far greater in size than his normal needs require in order to compensate for this aging factor. There is no such factor in the generator.

My thanks to Dr. Wick for this opportunity of comparing European standards with those existing in North America. (Applause)

DR. WICK: I feel we should be indebted to Mr. Berry for his discussion. I feel sure he has increased our knowledge of this equipment, especially as compared with the motor-generator sets available in America.

MR. E. K. RALSTON (Cleveland, Ohio): I should like to ask the speaker if he has had any experience with copper sulphide rectifiers.

DR. WICK: No. I said I have had no experience with this type of equipment. This is simply a report of conditions existing in England today, which are naturally quite surprising.

MR. RALSTON: We have had some little experience with those. We find among other things the capacity per unit is much higher than the copper oxide type. Of course we are only interested in building small-power units of approximately 100-ampere capacities. I might mention for your benefit that during probably two years of experience building these, we built quite a few and tested a lot of them, with probably two or three hundred per cent overload. We burned out switches and rheostats and transformers but we have never burned out a rectifier.

MR. BERRY: I think you might be interested in knowing that at the Bell Telephone Laboratories, where they have done such

a vast amount of experimenting, where the problems are so great that anything which would improve the efficiency of a machine would be tried, in discussing that with them I said to one of the doctors there, "No one can stand in the way of progress, no matter how much we generator manufacturers might want to continue the manufacture of generators. It certainly would be neither good nor wise for us to even want to stand in the way of progress, because anything that lowers the cost or improves the quality of plating is far more essential. What is the ultimate rectifier when the voltage generator has to give way to something more efficient?"

They said without any question that from the present information they had it was the metallic tube rectifier, but they said the problems there would require about another ten years for their solution so far as they could see. It was their opinion that the metallic tube rectifier was the rectifier of the future, so far as any present knowledge of the subject was available.

DELEGATE WOOD: I should like to ask Dr. Wick, where these rectifiers are being used in England, if they have made any comparisons of plating by the two methods or perhaps I should say by comparisons of the rectified power with the ripple against the pure D.C. power. It occurs to me that if a superimposed alternating current can reduce polarization, as I believe it does, the direct current with the ripple might act similarly.

DR. WICK: That point is well taken. One gentleman who discussed this matter with me said that he felt the solution should be fitted to the rectifier; that is, chiefly because of the lack of refined voltage control a wide plating range should be available. It was in that connection that I saw this chromium plating solution which had such a wide plating range. He stated that solutions for nickel plating were preferred which had a single salt concentration of about 500 grams per liter, because that gave a wider plating range.

So far as the effect of the ripple is concerned on the character of the plate, it would seem that there is no significant effect, because the rate at which these rectifiers are being applied in England, displacing motor generator sets, is very great, and at this time there are hundreds of thousands of amperes capacity in use. Would that be possible if there was any serious difficulty

experienced through the use of the metal rectifier with more or less ordinary plating solutions? Judging from that, I would have to say that there is no especial difficulty. Actually, I do not know.

DELEGATE WOOD: It is possible that the generator has a slight ripple. I wonder if Mr. Berry might comment on that.

MR. BERRY: Yes. You noticed the ripples there on the curve that Dr. Wick showed. In the first place, the rectifier inverts the lower half of the wave and turns it over. Therefore, you would get two ripples for each alternation. When you take three phases, you would get six ripples for each alternation. If you had sixty cycles per second, you would multiply by six and get the number. The number of ripples corresponds to about 360 as against an average of about 300 on a commutator type.

Colonel D'Orsey was doing quite a bit of work here, and I wish some of the Bureau of Standards men would take it up. That is to try to get the valve effect of superimposing an alternating current on the bus bars leading from a generator into the tank, working on the theory that possibly a little time element in there, a little valve action, might give some of the gases a chance to release themselves and give a much closer deposit. Colonel D'Orsey died just at the time when he was getting well started on those experiments, and I do not think you were ever able to go on with them. He was working on that superimposition of alternating current, and I think that has also been done in a number of other places, but the ripple effect on a commutator might be said to be almost identically the same as on the rectifier.

MR. HOGABOOM: That is on a segmented commutator.

MR. BERRY: Yes, sir.

DR. WICK: Very little work has been done to date on this effect of superimposed A.C.; undoubtedly more will be done in the future. In England Mr. Barkley, working at the University of Sheffield, found that there was an effect of superimposed alternating current on the electro-deposits. He found that decreased the effect of such deposits on the fatigue strength of metals. I believe the process for electrodepositing chromium utilizes superimposing alternating current also. There is undoubtedly an effect and it would be of considerable interest for us to find out just what it is.

DELEGATE WALTER MEYER: We have done a little work superimposing A.C. on D.C. current. We compare nickel deposited with a Watts solution under the same current densities with D.C. current and A.C. current superimposed upon the D.C. and used an oscillograph in the study. The curve was taken where it dipped below the axis and hence a reverse current was obtained. We could see no real differences in the character of the deposits. A.C. current superimposed upon D.C. is valuable for anode corrosion in gold solutions.

MR. HOGABOOM: Isn't that in gold solutions in refining where they wish to throw off the impurities on the anode so as to get higher anode efficiency? That has been in use in the mint for quite some time, I believe.

MR. P. J. RITZENTHALER (Milwaukee, Wisconsin): Under Dr. Watts I did some work on superimposing A.C. on D.C. We found in all cases it destroyed throwing power. It gave us much narrower plating ranges. We did work along those lines. So the A.C. seems to destroy the necessary throwing power in nickel solutions.

DR. BLUM: That is consistent with the fact that alternating current superimposed always reduces the polarization. That is why they use it in the gold anodes. That is why they use it to try to increase anode corrosion. By the same token, you are going to decrease the throwing power and I expect if there were any difference you would get a softer metal but poorer distribution.

DELEGATE WOOD: I should like to say that in a very small way I compared generator D.C. with battery D.C., in silver plating solutions using a Haring cell to measure the polarization. I found no measurable difference.

MR. F. L. MERRITT (Endicott, New York): I find that this superimposing of alternating on direct has more of an action such as you get from the effect of hydrogen peroxide in a solution or in other words, a depolarizing agent. If you have a curved surface over on each side and you are plating with nickel, you are bound to get air bubbles under there, or hydrogen, an accumulation of bubbles, causing black marks and large black pits. You will find that by superimposing alternating on direct you eliminate that. That was one of the best factors. I will

agree with the gentleman so far that it cuts down anode polarization.

PRESIDENT SLATTERY: Is there any further discussion on this paper?

MR. E. W. SKELTON (Wallacebury, Ont.): Is it not a property of all these rectifiers that at very low current densities the percentage rectification is very low and that we might expect increasing reams at very low output of these machines?

MR. RITZENTHALER: One thing I should like to bring out is this: Those installations that were shown on the board showed the rectifier hooked up directly to the tank. If we are going to have that in the plating room, the problem of corrosion becomes a very serious thing, because I played around a little with rectifiers and know if you have corrosion in there you destroy the rectifier. With the serious acid atmosphere in the plating department, I am afraid the life of these things might be short unless they are protected by some other methods. Insulation would cut down the cool effect so you might have heating trouble.

DR. WICK: It is quite possible that at the very low currents there might be a change in that oscillograph diagram. I have seen no oscillograms made under those conditions. That would be a very easy way of finding an answer to your question. Perhaps, as a result of this discussion that will be done. The metal rectifier is completely enclosed, and the source of air for its cooling is usually brought in from outside. Therefore, you have a superior condition as far as contaminated air is concerned.

DR. BLUM: I should like to comment on one angle of this discussion. In these days of rapid communication, of close coordination between various companies in different countries, and even from visits through foreign countries, one would judge at first that economic and commercial conditions are very much the same in the same industry. They look the same. If you go through a plating plant in Birmingham, it looks the same as a plating plant in this country. It is surprising, almost alarming, that conditions in English speaking countries can be so different, as Mr. Berry indicates, in the manufacturers' design and operation of generators. Therefore, this development, because it is a surprising development from its English acceptance, should be confined to conditions in England.

In other words, it may be assumed that those people know

what they are doing when they put in 100,000-ampere units capacity of equipment; that they must at least believe they are improving in one respect or another. It shows that there is still a great need for an adjustment or equalization of conditions in different countries in order to be able to say whether one thing is superior to another. I think that because of this discussion any doubts we may have had as the to wisdom of Dr. Wick presenting a paper on something on which he professed to have no first-hand information, are fully dispelled by the information that has been brought out in this meeting.

MR. L. H. LOCKWOOD (Lancaster, Pennsylvania): I have not heard anything stated in regard to the cost per kilowatt in comparison with the oxide rectifier and the generator set. Did you make such a statement?

DR. WICK: Do you refer to the cost of the equipment?

MR. LOCKWOOD: Yes.

DR. WICK: The equipment is said to cost about the same as motor generator sets cost in England.

MR. BERRY: In my paper I gave fifty per cent as the maximum that I was willing to acknowledge on the efficiency of the copper oxide rectifier.

DR. WICK: We are speaking of the cost of the equipment itself.

MR. BERRY: I have not any idea what the cost is.

DR. WICK: The cost of a 1,000 ampere unit of metal rectifiers is about the same as the cost of 1,000 ampere motor generator sets. Does that answer the question?

MR. LOCKWOOD: Maybe that might be the answer to their going to the rectifier.

DR. WICK: They seem to be pretty well stabilized in that respect.

MR. RALSTON: There seem to be a couple of questions that have been brought up here to which I might give an answer. In the first place, so far as cooling these rectifiers is concerned, it is not at all necessary to cool them with air any more than it is with a transformer. You can cool them with oil if you want to.

Another thing about taking care of the aging effect, as has already been suggested, tapping the primary; the transformer is probably one of the easiest ways. As long as you have a lot of taps on the primary of the transformer all you have to do is

move it up one year or a couple of years later to take care of the extra voltage drop. In other words, you do not have to make any other provision for that because you already have the primary on the transformer. All you have to do is to set it up another notch. That will take care of all the aging for another ten years.

MR. VAN WINKLE TODD: In replying to the question as to relative costs, I think the answer as given is entirely correct, based on the cost of a British motor generator set. But the average cost of a British motor generator set is about 18% less than an American type motor generator set or a motor generator set produced here, which would indicate that in a comparison of the cost, the British cost of manufacture of a rectifier and an American motor generator, would show a higher price for the American motor generator set than the British made rectifier, or an equal price for the British made rectifier and the British made motor generator set. However, it has been estimated that because of the great amount of hand labor required in producing a rectifier, the American cost would be very much higher than the British cost, and I think it is fair to say that that is the main reason for the lack of rapid development of the rectifier in this country. Means may be developed for producing the rectifier at what would be a competitive price.

From a study, however, of the present cost of production, the rectifier in the United States would be considerably more expensive than the motor generator set. I am only basing that on the time consumed in England in producing the rectifiers. It is very possible that that can be corrected and as Mr. Berry said, I do not think it is wise to attempt to stand in the way of progress; if it can be produced it undoubtedly will be, but in saying the cost of a rectifier and the motor generator set is the same, that is only true if the two English units are compared.

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# *The* Comparative Evaluation *of Modern* Finishes

*By LEO ROON*

**Read at Cleveland 1936 Convention**

IT seems almost impossible that seven years have gone by since I last had the pleasure of addressing your Convention in Toronto. Without doubt, these seven years will be indelibly impressed upon our memories. From the financial point of view, these are the years we want to forget and to put behind us, but from the creative point of view, these years will remain outstanding for the number of scientific and technical advances they introduced in all lines of endeavor. New ideas were born out of disaster and developed to fruition by tireless efforts to meet new conditions.

In our own field of surface coating materials, these years have witnessed the development of a whole new branch of finishing materials; namely, synthetics of the modified glycerol phthalate type, from the state where excessive enthusiasm proclaimed them to be the panacea for all finishing problems down to the point where they have found their proper niche between lacquers and oleoresinous finishes.

In these few years, more new raw materials have been developed for the making of film-forming products by the paint, varnish and lacquer manufacturer than in the entire one hundred years prior to this time. These raw materials include resins of the vinyl, alkyd and the phenolic types; new solvents of all classes, new plasticizers, new pigments, new driers and all of these run in number to the hundreds. New rubber compounds, new cellulose derivatives that, a short time ago, were expensive laboratory curiosities, are now commercially available, releasing new and interesting properties when correctly and skilfully formulated to meet the modern requirements of industry.

The new raw materials made available for our industry have opened up new fields of usefulness for organic finishes. A rather unique example of these new developments may be seen in the high degree of resistance to acids, alkalis, and other chemical

reagents, which it is now possible to incorporate into finishing materials. We can now produce a single protective coating which has excellent resistance to such diversive corrosives as nitric acid, caustic soda solution, and alcohol; concentrated hydrochloric acid, sulphuric and chromic acids likewise do not affect it. We have a photograph which illustrates in a striking way the protection which such a clear coating can give over a white finish, of a standard non-resistant type. Perhaps the most remarkable aspect of this test is that the clear top finish has actually prevented the reagents from creeping under it, even though its margin, or outside edge, is exposed to them.

The real problem of the progressive manufacturer of surface coating materials is to carefully and completely evaluate these interesting new materials and to make them available to you in their proper form.

In the matter of evaluation, these seven years have given us some surprises with respect to some of our previously conceived notions, but they have also yielded new methods of testing, as well as a clearer interpretation of the results of these tests.

Due to the limited time allotted us, it will be the purpose of this paper to summarize rather than to delve too scientifically into evaluation methods of our own, or those developed by such able observers as Dr. A. E. Schuh[1] and his co-workers at the Bell Telephone Laboratories, or those developed and released from time to time by Dr. H. A. Gardner[2] of the Institute of Paint and Varnish Research, to which, incidentally, we refer those who desire more detailed and specific information.

Until three or four years ago, technicians felt that they had a very useful tool for the evaluation of finishes in the various types of accelerated weathering machines, which attempted to simulate artificial changes of temperature, humidity, sunshine, etc., but the Paint & Varnish Division of the American Chemical Society was suddenly shocked by Dr. Gardner[3] of the Institute when he stated that results obtained by accelerated weathering could not be properly correlated with the results obtained on similar panels,

1. "Physical Evaluation of Finishes" by A. E. Schuh and H. C. Theuerer.
   Schuh, A. E., Ind. Eng. Chem., 23, 1346-52 (1931).
   Schuh, A. E., and Kern, E. W., Ibid., Anal. Ed., 3, 72-6 (1932).
2. "Physical and Chemical Examination of Paints, Varnishes, Lacquers and Colors" by H. A. Gardner.
3. Technical Bulletins, 1936 series, National Paint, Varnish & Lacquer Manufacturers Association.

which had been given actual exposure in Florida and at other test points. So the accelerated weathering machine is today a tool of limited use to be relied upon only for comparative tests.

Another field in which it has become necessary to abandon accelerated chemical tests in favor of a plain ordinary service testing is in the case of perspiration resistance. For years, finishes were given a spot test with oleic acid, and if the finish did not break down in a matter of a few days the finish was considered to be perspiration resistant. Experience, however, of the last few years has taught us that nothing takes the place of perspiration in a perspiration test, and so now, as has been described by us in a previous article, discs are coated with the finishing materials in question, attached to a belt, and carried in contact with the skin around the stomach. The belt is removed regularly for examination against the standard disc until the finish breaks down. This belt illustrates both satisfactory and unsatisfactory finishes, in a perspiration test.

Then along came Dr. Schuh[1] who after several years of work came to a conclusion which he aptly summarizes in the following words: "The consumer of finishing materials is more interested in the health of a finish than in the manner of its death. In the customary methods of exposing finishes, the paint technologist is forced to act too much as the coroner and too little as the diagnostician. It has now been definitely learned that by the time visible signs of failure make their appearance, question as to whether the finish has finally failed by checking, cracking, or scaling becomes really a matter of quibbling. If the health and strength of a finish could be measured and followed in its youth and maturity, serious organic defects could be spotted and in the hands of the intelligent formulator immediately corrected." In other words, this new concept is analogous to the custom of the Chinese who pay their physicians to keep them well rather than for curing them when they become ill.

This suggested procedure is a great advance for our industry for it gives the technologist new and useful tools with which to observe weaknesses which may develop during the life of a finish and enable him to so formulate as to avoid finish failure under certain service conditions.

However, this kind of scientific testing must be carried out under carefully controlled conditions of uniform temperature

and humidity; the panels must be very carefully prepared under conditions which yield films of uniform thickness, and the actual measuring of abrasion resistance (wear), impact resistance (adhesion) and flexibility must be carried out under properly controlled conditions regardless of the apparatus used. Comparative results of scientifically controlled tests, not only provide definite evidence of the superiority of one finish over another, but usually permit the expression of such results in tables or graphs for subsequent reference.

It is a sign of progress to note how many of the larger users of finishing materials are setting up their test laboratories, which enable their technicians to evaluate finishes under controlled conditions, and set up specifications from which to purchase their finishing materials to meet the standards which they have set up. But by and large, however, the average purchaser of finishing materials has to rely upon the ability and integrity of the lacquer, paint or varnish manufacturer to furnish him with finishing materials, which will sell his products and keep them sold, finishes which will completely satisfy the consumer with their appearance, life, and utility.

In a great many of such organizations, the finishing foreman is a man who had has years of experience in the application and in the observation of surface coating materials. It is a most surprising thing with what great accuracy he can evaluate the characteristics of the finish in the absence of scientific implements. He applies the finish to give the required appearance, and after the proper drying time he runs his sharp and horny, pet trained fingernail over the surface, mentally registering the measure of toughness of the finish.

Then out comes his trusty knife, and he whittles into the finish to see whether the film is alive and curly or whether it chips and flakes away from the surface; thus he registers the measure of adhesion. When he bends the panel back and forth a number of times and finds that the film distends to extent of the expansion of the metal, he registers his measure of the flexibility of the film. But experience has taught him that this characteristic of liveliness and distensibility of film changes with age and when he places the finish into his low temperature steam oven for long periods of time, and repeats his knife test and

bend test without loss of adhesion or flexibility, he is in effect paralleling the scientifically controlled tests which are carried on in elaborately equipped laboratories. While his results do not permit of tabular or graphic expression, still, for his practical purposes, his results are equally as reliable as those more precisely arrived at. Regardless of the passage of time, the development of new thoughts, or the entrance of many new raw materials into the field, there remains unchanged, the old ideal of *permanent* flexibility and adhesion as the paramount criteria of a good finish.

It will interest you, I am sure, to tell you in closing that intimate talks with highly reputed paint, varnish and lacquer manufacturers in the important countries of Europe revealed the gratifying fact that the rest of the industrial world recognizes the leadership of the United States in the technique of lacquer and synthetic manufacturing, and in its applications.

**ANNOUNCEMENT**

Since the Cleveland Convention, the details of the Secretary-Treasurer's and editor's offices have been carried on as usual in Springfield. The writer will sever all connection with the company employing him on Sept. 1, 1936 and will be available to render whatever service he can to all the branches in addition to the work outlined by President and the Executive Committee.

With the exception of a nominal sum for the services of a typist to answer the correspondence connected with the above mentioned offices, there will be no salary or compensation expected from the A.E.S. until the office of the Executive-Secretary officially opens on the above date.

W. J. R. KENNEDY,
*Executive Secretary*

# *The Abstract Section*

JAMES W. HANLON, *Chairman, Program and Educational Committee*

**Pickling and Plating Brittleness of Steel.** H. SUTTON, *J. Electrodepositors' Tech. Soc.*, **11**, preprint, April, 1936—An extensive review of the literature shows that it has been known for over 60 years that steel is made brittle by acid pickling. This effect is attributed to absorption of hydrogen, and is most marked with hardened steels. Addition of colloids (inhibitors) to the acid reduces the embrittling effect. More brittleness is caused by plating in cyanide than in acid baths. Anodic pickling in 30% sulphuric acid containing 3 oz/gal of potassium dichromate cleans the steel without causing brittleness, and appears to prevent embrittlement during subsequent plating. W. BLUM.

**An electron-diffraction study of the structure of electro-deposited metals.** G. I. FINCH and C. H. SUN. *Trans. Far. Soc.*, **32**, 852 (1936)—It was found by electron-diffraction measurements that the structure of an electrodeposit is profoundly affected by that of the base metal, except in those cases where the adhesion of the deposit was poor. When one metal displaces another chemically, alloys of the two metals are formed, but not when one metal is deposited upon another. W. BLUM.

**The Roentgenographic (X-ray) study of zinc and cadmium films deposited in the presence of colloids.** L. PALATNIK, *Trans. Far. Soc.*, **32**, 939 (1936)—An X-ray study showed that the addition of colloids to an acid zinc bath or to a cyanide cadmium bath brought about the formation of crystals perpendicular to the surface of the cathode. (NOTE by Abstractor. This observation is surprising, since it is generally found that colloids reduce the tendency for crystals to form in electrodeposition. W.B.) W. BLUM.

**The use of nickel in gramophone record manufacture.** E. A. OLLARD, *Nickel Bulletin*, **9**, 121 (1936)—The methods used in England for reproducing the shells used for making records are described. At various stages, the shells are nickel plated, or are made with an initial nickel layer. The bath contains:

| | *oz/ U. S. gal* |
|---|---|
| Nickel sulphate | 27 |
| Ammonium chloride | 1.6 |
| Boric acid | 1.6 |
| pH (quinhydrone) | 5.7 to 5.9 |

and is continuously filtered.

The copper deposits are made from a bath containing:

| | *oz/ U. S. gal* |
|---|---|
| Copper sulphate | 27 |
| Sulphuric acid | 11 |

Phenol sulphonic acid is sometimes used as an addition agent. The final "stamper" shells are plated with chromium to increase their service.

W. BLUM.

**Addition agents in electroplating.** J. LIGER, *Galvano*, March 1936, page 17—In summing up a study of addition agents to cadmium plating baths, the author finds that the formula of Westbrook, recommending the addition of 12 g/l red turkey oil and 1.6 g/l nickel sulfate, gave dependable results over a sufficiently wide range to be recommended for practical plating. The use of gelatine, dextrine, nickel sulfate alone, or red turkey oil alone, added as brighteners did not give comparable results.

The use of addition agents to any plating bath should be made only by an experienced person using great care, as the results obtained depend upon the control of many variables other than the concentration of addition agent.

C. T. THOMAS.

**The role of films in the electrodeposition of metals, Part II.** By WALTER R. MEYER. *Metals and Alloys*, June 1936, pp. 155-159—Second section of a correlated abstract on films. Article first discusses polishing films, giving highlights of work done by various investigators in the last 30 years, including researches on the well known Beilby amorphous layer. Through the development of the electron diffraction camera more careful study of surface films has been made possible. The findings have, in general, supported the existence of the Beilby layer.

Subsurface effects are greater the harder the degree of work upon the surface. These effects were studied by means of X-rays. Distortion was found to penetrate more than $2.5 \times 10^5$ angstrom units below the surface.

*Study of structure of thin films.*

A review of thin films deposited by cathode sputtering was given in order to study possible similarity to plated coatings. Structure of thin films was found to be crystalline and their orientation and size is dependent on material on which film was deposited. Thus, basis metal is important here too.

*Effect of structure of basis metal on structure of electrodeposit.*

George Hogaboom was the first, way back in 1916, to point out probable effect of basis metal on the deposit and in 1921 pointed this out on one of

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Dr. Blum's photomicrographs of multiple layers plated on rolled copper. Experiments run by Blum and Rawdon showed that when basis metal was etched, continuation of basis crystals was noted, but when polished base was unetched, this tendency was absent.

Hothersall found that continuation of basis metal is possible (1) when deposit and basis metal belong to same crystal system (2) when both belong to different systems. Higher current densities tend to cause non-orientation. Adhesion of deposit is greatest where continuation of basis metal crystals occurs. Polishing films, passive films and other films prevent this.

*Films on electrodeposits and unplated metals.*

Chromic acid dip used to give passive film on cadmium to prevent tarnish. Chromic acid treatment of zinc gives similar results as does chromate treatment on silver.

*Anodized aluminum has definite protective value.*

This article should be read by everyone connected with the plating industry as it is of the utmost basic importance to both the practical and theoretical plater. PHIL J. RITZENTHALER.

**Inhibitors: Safe and Dangerous.** By VLICK R. EVANS, Cambridge University, Cambridge, England—In a previous article, the author discussed the theory and general reactions of inhibitors. The present article illustrates specific actions under varying conditions. Particular attention is given to chromates as inhibitors. The protective qualities of oxide, paint, and metallic coats are analyzed. E. T. SHEEHAN.

**Colloidal and Surface Aspects of Metal Cleaning and Finishing.** IV. By ALBERT L. KAYE, Sc.D.—The use of electron diffraction analysis is suggested for the examination of surfaces and surface films. For example, minute traces of an oil or the nature of films formed on metals in air may readily be determined. The apparatus utilized in diffraction analysis is described. E. T. SHEEHAN.

**Metal Rectifiers to Supply Current for Plating.** A. SMART. *Electrodepositors' Technical Society*, London, England, *Metal Industry*, July 1936—In a brief but comprehensive manner, the author lists the various types of rectifiers and gives the advantages and disadvantages of each kind. He explains why the metal rectifier is adaptable to plating, gives the theoretical principle governing it and further, simply explains the construction of two types of metal rectifiers; i.e. the washer type and the plate type. The advantages of these two types are discussed and their proper use indicated. There is further discussion concerning the control of the power output of the rectifier and the author concludes by stating as his opinion that there is a definite field in the plating industries for metal rectifiers because they can and do reduce power costs. V. SHEEHAN.

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# Explosion of a Second-Hand Air Tank

Before buying a second-hand object of any kind, the prospective purchaser should take every possible precaution to make sure that it is wholly suitable for the intended purpose and, if it is of a type that would be likely to endanger life or property in the event of failure, that it can be used *safely* under the conditions to which it will be subjected in service. In the case of a pressure vessel, this means that the buyer must assure himself that it is of sufficient capacity for the work to be done, and that it will withstand the pressure required to perform the operations that are to be conducted.

A recent air-tank explosion in a garage, emphasizes the special importance of the last-named precaution, although, fortunately, no personal injuries resulted from this particular accident, and the property damage amounted to only a few dollars.

The tank referred to was bought a short time before the explosion occurred, from a dealer in used objects of this general nature, who said that it had been represented to him as being safe to carry an air pressure of 350 pounds. The vessel was installed in the vertical position and was connected to a one-cylinder air compressor. It was 21 inches in diameter and 48 inches in length and was constructed of steel plate $\frac{1}{8}$ of an inch in thickness. The longitudinal and head seams were welded. Both heads were dished in; that is, the convex side of each head was subjected to pressure. The average operating pressure was 160 pounds, and the tank had a safety-valve set to relieve at 190 pounds.

Failure of the vessel took place at the lower head seam which gave way throughout the entire circumference of the tank. Leaving the lower head behind, the remainder of the vessel shot upward, passing between two roof joists and tearing a hole through the roof boards. According to the owner, the tank went up in the air about 100 feet and then fell back on the roof of the garage, tearing away some electric-power wires in its descent and further damaging the roof slightly.

This seems to have been a case where too much was taken for granted. When a dealer asserts that a particular tank can withstand a certain pressure, the prospective buyer should take every precaution to assure himself that the statement is correct. For example, in a state or city where the *Code* of the American Society of Mechanical Engineers is in effect, he should make sure that the vessel is properly stamped with the A.S.M.E. symbol and with other data required by the *Code*, including the maximum pressure allowed on the tank when new. It is probable that the allowable pressure on a second-hand vessel will be somewhat less than that for which it was originally designed, and therefore a qualified boiler inspector should be consulted in order to determine just what that pressure may be.

When a vessel has no A.S.M.E. stamps it will be unacceptable in a *Code* locality; and if there is no indication of its age or the quality of material and workmanship used in its construction, it will be impossible to determine, precisely, the pressure that may be allowed upon it even in a non-*Code* state. In a case of this kind, it is always advisable to make *minimum* allowances for strength of material and for construction details. Competition often leads to the adoption of inferior

construction methods and of material of poor quality and inadequate thickness. Many air receivers and certain other pressure vessels are made of what is known as "tank steel" which has a tensile strength varying from 45,000 pounds to 50,000 pounds per square inch, whereas steel of approved quality for pressure-vessel construction has a tensile strength of 55,000 pounds (or more) per square inch, as well as high ductility.

The shell of the tank under consideration was ⅛ of an inch in thickness (the *Code* requirement is $\frac{3}{16}$ of an inch for vessels from 16 inches to 24 inches in diameter) and apparently no information was available concerning the quality of material and workmanship. A simple calculation will show that there would have been a stress of nearly 29,400 pounds per square inch on the shell of the vessel if it had ever been operated at 350 pounds' pressure. This is dangerously high, because steel of good quality begins to yield or stretch at 27,500 pounds per square inch.

Even at 190 pounds (the pressure at which the safety-valve was set) the stress on the shell would have been about 16,000 pounds per square inch, which is far more than is allowable even for a *seamless* tank of its size. Actually, the tank had a welded seam of unknown strength. Even if this seam had had an efficiency of 85 per cent. (this is approximately the maximum allowed for a first-class welded seam) of the strength of the solid plate, the stress on the seam would have been about 19,000 pounds per square inch, which is excessive for vessels of this type constructed of low-carbon steel.

An element of weakness was introduced in this tank when the heads were installed *convex* to pressure. This is an inferior method of construction which should be avoided whenever possible. With modern welding methods and equipment, heads installed *concave* to pressure—a far stronger arrangement—can easily be welded in place.

Pressure on the convex side of a head tends to cause the head to reverse itself, and when this occurs an exceedingly heavy stress is suddenly thrown on the circumferential seam. Although it is known that many pressure vessels have failed in this way, the accompanying illustration shows that the head of the tank did not reverse itself but is still in its original form.

It is wholly inadvisable for a person unfamiliar with the construction of pressure vessels, to buy a second-hand object of this kind on his own responsibility, or to rely too implicitly on the representations of a dealer who may be thoroughly honest but may be no more expert along mechanical lines than the purchaser. A prospective buyer should ask advice from a disinterested person—preferably a qualified boiler inspector or boiler maker—and have him examine (and test, if necessary) the vessel to make sure that it is of adequate capacity and in safe condition, and that it complies with any code or other requirements that may be in effect in the locality where it is to be installed and used. It would be far better, of course, to avoid the uncertainties that are always associated with second-hand objects, and to buy a *new* tank that has been built to A.S.M.E. *Code* specifications which insure the use of suitable material and of proper construction methods.

*The Travelers Standard*

Business and Social News

# BRANCH NEWS

Educational Activities

AMERICAN ELECTRO-PLATERS' SOCIETY

## *ANDERSON BRANCH*

Anderson Branch held its monthly dinner meeting July 13, 1936 at the local Y.M.C.A. There were twenty-five members and guests present despite the temperature of 100 degrees plus. Little food, but vast quantities of iced tea were consumed.

Our librarian, Mr. Wagner, presented the showing of a two reel film "Nickel," which traced the production of nickel from the mining of the ore to the final electrolytic refining of the nearly pure metal. The pictures were very interesting and gave a clear idea of the production of nickel, of which, most of us were unfamiliar.

After the movies, we had a short business session to determine a course of action on delinquent members. After a good deal of discussion, president Minton appointed a committee to make a survey of our membership roll and, through letter or personal call, get a statement from them as to their intentions.

The meeting was adjourned at 9:45 P. M.

L. R. HINSCH, *Sec.*

## *MILWAUKEE BRANCH*

A regular meeting of the American Electro-Platers' Society, Milwaukee branch was held July 9, 1936 at Lipps Hall.

Our new President, Dexter Rhodes presided.

Although the evening was very warm the attendance was fine.

One applicant, Mr. Wm. DeCheck was elected an associate member.

Mr. Jack Geissman, picnic chairman, called on Bob Steuernagel, Paul Krause, Roman Binder to help with picnic arrangements. Ray Goodsell will be manager of the crack Milwaukee branch ball team.

Don't forget August 16th is the date of our joint outing, Charmaine Resort, Lake Marie, Antioch, Illinois. The price is $1.00 per each male adult, refreshments included.

Anyone wishing to have a steak or chicken dinner — get in touch with Jack Geissman for details.

R. C. BINDER, *Sec'y*

## CHARLES H. BUCKSHORN

Charles Henry Buckshorn, 42, who recently came to Elkhart from Chicago to take a foremanship at the Adams-Westlake plant, died at the Elkhart General hospital, after an emergency operation for ulceration of the stomach.

The body, was taken to Cincinnati, where burial was made under Masonic auspices. Mr. Buckshorn was a member of a lodge at Dubuque, Ia.

Surviving are his wife, Betty Reynolds Buckshorn; a son, Charles H. Buckshorn, Jr., of Cincinnati, his mother, Mrs. Ida Buckshorn of Cincinnati, and a brother, Fred, and a sister, Mrs. Margaret Finnell, both of Cincinnati. Mr. Buckshorn was born in Cincinnati, May 6, 1894, and went from that city to Chicago 20 years ago. He was a member of the American Society of Electro-Platers.

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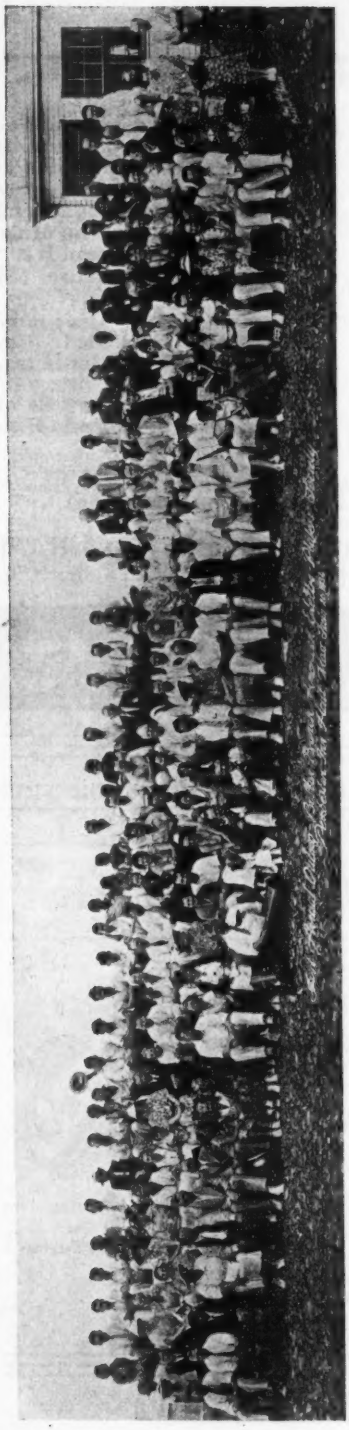

## Report of Outing of *BOSTON BRANCH*

Boston branch held its first annual outing Saturday, July 25th at the Pemberton Inn, Hull, Mass.

One hundred and seventy-five men, women, and children enjoyed a day of sunshine, sports, fun, and a very fine dinner never to be forgotten. The members and their families turned out fine and also the supply houses were well represented with our old friend Bob Leather taking pictures of the officers and all the events—many thanks to you, Bob.

We also had with us the Executive-Sec'y. He gave a short talk on what was expected of all the branches in helping get advertisements for the MONTHLY REVIEW asking each member to try and get an advertisement for the REVIEW. He also congratulated the branch on the fine work it has done in the past six months.

Boston branch wishes to thank all who so kindly donated the fine prizes to make the outing a grand success, also the many visitors who came a long distance to be with our friends. We feel it an honor to have such staunch friends, and as a branch of the A.E.S. feel we want to reciprocate in any way to our many friends, should the occasion arise.

Among the many visitors who came a long distance, were Mr. John Oberender and party from New Haven, Conn. Bill Chase and Bill Brown from New York, Bob Leather and wife from Waterbury, Conn., Oliver J. Sizelove and wife from Newark, N. J. Frank Clark and W. J. R. Kennedy Executive-Secretary of the A.E.S. of Springfield, Mass., Mr. R. T. Marshall and family of Worcester, Mass. Mr. and Mrs. Hughes of the Oakite Co., Mr. A. Braun from Bridgeport, Conn., and many others;—thanks to them all.

Louis Gale was the umpire of the ball game and was he nervous? His wife showed him who is the boss now by winning the spike driving contest.

Harry Lack was out when he was in. That's what he says;—you get it?

Andy Garrett and Charley Hardy looked like a couple of gypsies in their tent. They drank a whole case of orangeade. Pencil in one hand and the tonic in the other they did a fine job on the registration.

Charley Campbell certainly was behind this outing and he wants it known that he's not an old timer. How about that, Charley?

The Campbell family certainly showed that they are there as athletes.

The Baker family were represented and also showed that they are athletes.

Ed DeLorme certainly kept the record of the sports events and not one argument — how about it? Ed, what do you say?

Bert Sage took care of the advertising and correspondence and did he he do a great job well. The prizes can answer the question for you. Well done good and faithful servant, Bert.

Bill Cahill gave out of gas near the finish of the fat man's race letting Mr. Braun in by a belly.

The kiddies had a fine time hunting for the pennies in the sawdust.

Other prizes were won by the following; Charles Foley, Mrs. Louis A. Gale, Mrs. Bob Leather, P. Furlong, J. E. Grant, James Campbell, G. Campbell, Ed. Nevins, A. A. Brunell, Mrs. Bert Sage, Ed. Foster, B. Sage, and Wm. Lawrence.

The committees were as follows:— Arrangements, Arthur J. Mintie, Charles F. Campbell, Roy Roscoe, Harry J. Lack, Charles O. Hardy, Edward C. DeLorme, Louis A. Gale, and Andrew W. Garrett.

Advertising—Bert Sage.

Tickets—A. W. Garrett.

Sports—Arthur J. Mintie, Charles O. Hardy, Edward G. DeLorme, and Harry J. Lack.

There not being enough time to run all the races here are the results of those that were run.

100 yd. dash for boys under 15 yrs.—won by A. Lawrence.

100 yd. dash for girls under 15 yrs.—won by Miss D. Sage.

100 yd. dash for men—won by L. Campbell.

75 yd. dash for women—won by Miss G. Campbell.

Fat man's race, 50 yds.—won by A. N. Braun.

Pipe Race for men—won by Edward Grant.

Relay Race for girls won by—D. Sage and A. Lawrence.

Relay Race for men—won by J. Nee and L. Campbell.

Relay Race for boys—won by S. Baker and S. Perrow.

Relay Race for women—won by M. Hardy and L. Potter.

Quoits Contest—won by Walla and Grant.

Three Legged Race for men—won by J. Campbell and Bill Lawrence.

Rolling pin throwing contest—won by Mrs. Axelrod and D. Greeley.

Chinese Mustor was won by C. Hardy.

Walking contest—won by J. Campbell.

Spike Driving contest—won by Mrs. L. Gale for Women.

Shoe Race for children—won by E. Fowhey.

Spike Driving contest—won by A. Arthur Baker for men.

Race for the little Tots, 20 yds—won by J. Sage and B. Baker.

Thanks to you all until we meet again.

A. W. GAREETT, *Sec'y.*

## *CHICAGO BRANCH*

The regular monthly meeting of Chicago Branch was held July 11, 1936, at the Atlantic hotel, President G. Jelinek presiding and all officers present. The applications of Mr. V. Kubish, Mr. W. B. Tall, Mr. H. W. Kuckuck, Mr. D. B. Stockton, read and committees appointed on same.

Mr. E. L. Ingram was reinstated to active membership.

Mr. F. K. Savage was elected to Associate membership. Mr. J. J. Walsh reported the suden death of Mr. C. H. Buckshorn at Elkhart, Ind. Chicago Branch officers and members extend to Mrs. Buckshorn and Family their deepest sympathy.

Mr. F. J. Hanlon as chairman of the Chicago branch picnic committee reported that all plans were well under way for the Joint picnic of Chicago & Milwaukee branches. Mr. J. Geissman of Milwaukee branch was appointed general chairman of the picnic with an able corps of committee men. The picnic will be held Sunday, August 16, 1936, at the Charmaine Resort, Lake Marie, Antioch, Ill. There will be plenty of prizes and a good time is sure to be had, so remember the Date.

Due to the heat it was decided to omit the question box for this meeting.

J. W. HANLON, *Sec'y*

## *PHILADELPHIA BRANCH*

Philadelphia Branch Meeting called to order by President A. Hirsch. Minutes of previous meeting read and approved. Application of Mr. Joseph Raymond approved by the Board of Managers. Moved and seconded that Mr. Joseph Raymond be elected to become an active member of Philadelphia Branch. New applications of Harry M. McCall as an active member, Mr. DeSoi as an associate member, and Mr. Joseph Krazenski as an associate member. Moved and seconded that all applications be referred to the Board of Managers for approval. Mr. Harry Snyder was appointed Chairman of Banquet Committee. Mr. J. Nelson was appointed Chairman of the Educational Committee. Mr. Del Robson was appointed Editor of the Quaker City Reminder for the coming year. Under good and welfare, Mr. J. Nelson, our Librarian, gave a very interesting talk which was well received. We can look for a very interesting year, as he gave a very good idea of the program he has mapped out, and hopes to have the same ready for the next meeting.

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The inclosed cost of the Convention proceedings to $5.00 per copy was received. It was voted to order one copy of same. There being no more business the meeting adjourned.

R. E. JACKSON JR., Sec'y

## *ROCHESTER BRANCH*

On Saturday, July 18 the Rochester and Binghamton-Elmira Branches held their first annual get-together and outing at the Three River Point Inn near Syracuse. The outing was well attended by members and friends of both branches, Rochester sending out a bus load in addition to those who drove out. A buffet luncheon, arranged for by the sales associates, was served at one o'clock and a hearty vote of thanks is due the donors by all the recipients, and is whole heartedly given. A baseball game was played after the luncheon between the Binghamtonians and the Rochesterians and after a hard battle the Rochesterians finally won. The only sour note was our Umpires and as umpires usually are they were absolutely rotten, Vest Gartland and Frank Mesek being the offending gentlemen in this case. At one stage of the game it was a close question as to whether they would be ducked in the river or not. The cup that brings good cheer was filled to overflowing all afternoon. At six o'clock a turkey dinner was served during the course of which several of our talented young members gave an exhibition of the terpsichorion art which was nothing short of marvelous. Mr. Henry Norgren and Mr. Hilgenberg were the two outstanding terpsichores who left their audience gasping. President Austin Fletcher of the Binghamton branch and President Frank Kohlmeier of the Rochester Branch added their bit to the occasion by a spontaneous burst of oratory. After the dinner and a short social period the members of the Rochester Branch were assembled into the bus and left for home reaching Rochester at twelve o'clock. Everybody voted it was a grand outing, and the co-chairmen, Mr. Henry Norgren of the Rochester Branch and Mr. Austin Fletcher of the Binghamton Branch together with their assistants Mr. R. O. Warner and Mr. Ray Berghold deserve the thanks of all the members for one swell-elegant time. We also wish to thank the sales associates for their co-operation in the distribution of the tickets.

JUDSON R. ELSTER, *Sec'y*

## *NEW YORK BRANCH*

The New York Branch held the first of its Summer schedule of meetings,

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The BIAS Buff is easy for the operator to use —it saves his strength —it does the work faster and better.

The BIAS Buff does not streak the work. The BIAS Buff throws off no threads—makes the polishing room cleaner, healthier.

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REQUIRES ONLY A MINUTE TO CHANGE FROM ONE SOLUTION TO ANOTHER.

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1910 MAYPOLE AVE. CHICAGO, ILL.

the second Friday of each month for July, August and September. There were thirty-seven members present. Much of the time was taken up with discussion of preliminary details of the 1937 convention to be held in New York and the appointment of committees for the purpose of hotel selection for headquarters, educational papers, publicity, etc. Past president John Rolff, president Ralph Liguori, Trustees Justus Stremel, John E. Sterling and Ben Nadel and Benjamin Popper were appointed to form the nucleus of a representative group to carry on preconvention work. The committees will be augmented as time goes on.

The second half of the meeting and educational session was presided over by the librarian, Aaron Englander. Two lively discussions were held relative to monel metal, its uses, characteristics and plating and finishing thereof and also discussion on color gilding, the varied antique finishes in gold and the composition of the solutions. The latter subject was the cause of considerable discussion. Conflicting thoughts and opinions were held by some of the platers successful in this line.

At this meeting the Branch elected to membership Mr. Louis Henry Cates of the Enequist Chemical Co., Inc., Brooklyn, N. Y. home address, 645 Ocean Parkway, Brooklyn, N. Y., as an associate member, and received application of Duncan B. Copland of the American Banknote Company, who makes application as an active member.

The meeting was called for adjournment at 11.15 P. M.

FRANK J. MACSTOKER, *Sec.*

**WANTED** to buy for spot cash a mailing list of firms doing oxidizing. Potential users of McKeon's *Liquid Sulphur* "The Oxidizing Agent of Today". — Sulphur Products Co., Inc., Greensburg, Pa.

## JAMES E. NAGLE DIES

### Pioneer in Electro-Plating Field Fails to Survive Operation; Spanish War Veteran

James E. Nagle, president of James E. Nagle & Sons, Inc., electro-platers, died in St. Vincent's hospital following an emergency operation for appendicitis. He was 58.

Mr. Nagle, a pioneer in the electro-plating field, and his four sons founded the concern their father headed in 1927. The plant is at 2042 Hawthorne Street. Edwin J. Nagle is vice-president of the firm; Richard J. Nagle is secretary-treasurer and James Nagle, Jr., and Donald Nagle are officials. The father had worked at the electro-plating trade since he was a youth.

Mr. Nagle's death was unexpected. He was taken to the hospital from his home at 4311 Overland Parkway last Friday night and rallied after the operation. Complications caused death.

Mr. Nagle, a life long resident of Toledo, served with the American forces in Cuba during the Spanish-American War. He was a member of the Knights of Columbus and of St. Agnes' Church. Burial was in Calvary Cemetery.

Mr. Nagle leaves, besides his sons, his wife, Susan, and a daughter, Mrs. Ruth Huss, wife of Dr. J. D. Huss, also of Toledo, and 11 grandchildren.

# CLEPO

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Wm. Voss, Metropolitan G. Gehling, Pennsylvania
J. Hay, Western

# *Membership Report*

*To July 18, 1936*

## ELECTIONS

Louis Henry Cates, Enequist Chemical Co., Inc., Brooklyn, N. Y.
Associate New York Branch

William DeCheck, 3431 8th Ave., Racine, Wis.
Associate, Milwaukee Branch

F. K. Savage, c/o C. G. Conn Ltd., Elkhart, Indiana
Associate, Chicago Branch

## APPLICATIONS

John E. Grant Jr., 50 Altoona Rd., Dedham, Mass.
Boston Branch

Duncan B. Copeland, American Banknote Company New York,
New York Branch

Joseph Raymond, Henry C. Betz & Co., Phila. Pa.
Active, Phila. Branch

V. Kubish, 3150 N. Racine Ave., Chicago, Ill. Active

H. W. Kuckuck, 2119 Parnell Ave., Fort Wayne, Ind. Active

W. B. Tall, 10 W. Elm St., Chicago, Ill. Associate

D. B. Stockton, 1943 Walnut St., Chicago, Ill Associate

John Paul Frederick, the American Dirigold Corp, Kokomo, Ind.
Anderson Branch

Roy E. Shockley, the American Dirigold Corp., Kokomo, Ind.
Anderson Branch

## RE-INSTATED

E. L. Ingram, 2453 Walton St., Chicago, Ill. Active

## DEATH

C. H. Buckshorn, 941 Galt St., Chicago, Ill.

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